Report of Transnational Access Projects

Project ID: C3-TA1-44-5-2

Principal investigator: Olgert Gjuzi, Academy of Sciences of Albania

Project team (if applicable): Geosciences & Geoengineering, Academy of Sciences of Albania

Project title: Site Characterization of Liquefaction and Critical Infrastructure using Seismic Array

Project acronym: Infra Soil Array

Hosting installation: MobSeis Mobile Seismic Array (TA1-44-5), TNO, Netherlands

Hosting team: Vincent Vandeweijer, TNO, Netherlands

Period of access: *21-10-2025 – 21-12-2025*

Report of activities:

The Geo-INQUIRE Transnational Access activity was carried out within the framework of the InfraSoilArray project, with the main objective of improving the seismic site characterization of the Durrës sedimentary basin, Albania. The activity used the MobSeis Mobile Seismic Array facility hosted by TNO – Geological Survey of the Netherlands through ECCSEL ERIC. The facility is designed for flexible active and passive seismic acquisition, including subsurface characterization, earthquake and noise monitoring, and the detection and localization of seismic events.
The field activity was mainly focused on the Durrës basin, one of the most important coastal and urban sedimentary basins in western Albania. This area was strongly affected by the 26 November 2019 Mw 6.4 Durrës earthquake, which highlighted the importance of local site effects, soft sedimentary deposits, shallow groundwater conditions and liquefaction-related ground response. Most measurements were therefore performed within the Durrës basin and its surrounding sectors, including areas where liquefaction-related effects had been previously observed, representative basin transects, and critical infrastructure or urban sites.

The survey included coastal and lagoonal sectors such as Juba, Rinia, Dajlani, Plepat and other parts of the Durrës coastal plain. Infrastructure-related sites included the Port of Durrës, Dajlani Bridge, Plepat Bridge, the Water Treatment Plant and selected urban sectors. Representative profiles were also acquired across the basin, including sectors between the Shënavlash and Spitallë hills, in order to investigate lateral variations in resonance frequency, amplification level and shallow subsurface stiffness. In addition to the main measurements in the Durrës basin, complementary measurements were carried out at selected important sites outside or beyond the main basin area, including Buna Bridge, Epoka University and the Tirana Artificial Lake Dam. These additional measurements were

used to test the applicability of the mobile seismic array in different geological and infrastructure settings and to obtain preliminary site-response information for critical structures of regional interest.

Figure 1. Distribution of measurement sites in the Durrës basin, including liquefaction-observed sectors, critical infrastructure sites and representative basin transects.

Geo-INQUIRE is funded by the European Commission under project number 101058518 within the HORIZON-INFRA-2021-SERV-01 call

The measurements were performed using the MobSeis mobile seismic array provided by TNO. During the access period, 32 autonomous three-component stations were deployed in the field. The system is based on Sercel Unite acquisition units coupled with integrated three-component digital accelerometers, allowing both stand-alone and array-based operation. The sensors operated at a sampling frequency of 500 Hz and were suitable for both passive ambient-noise recordings and active-source seismic measurements. The flexible station spacing and array geometry allowed rapid deployment in different field configurations, including single-station measurements, linear arrays and circular arrays.

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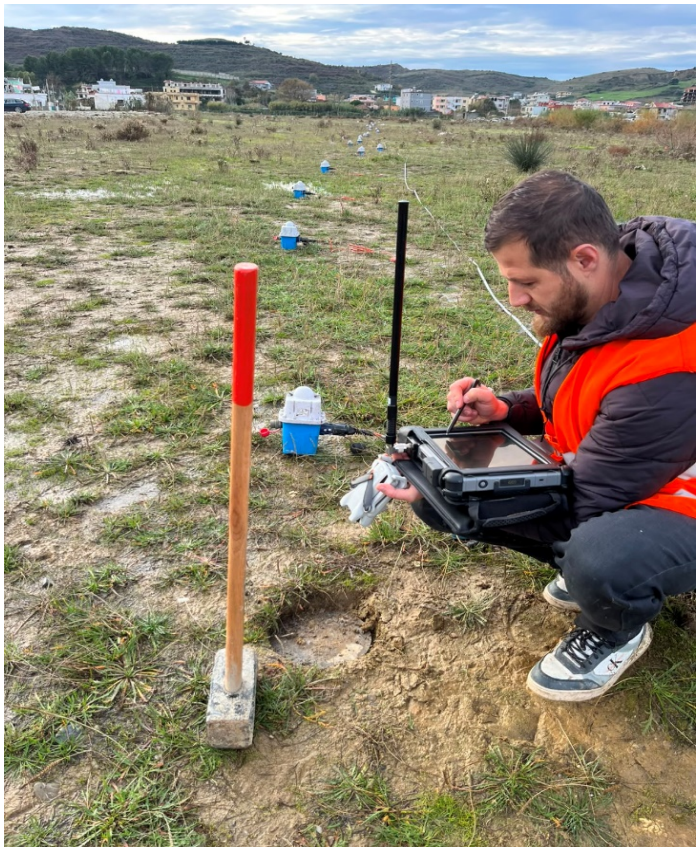

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Figure 2-13. Fieldwork activities in the Durrës area and a project meeting held at the offices of the Academy of Sciences of Albania.

During the campaign, seven long-duration single-station measurements, twenty-three linear arrays and three passive circular arrays were acquired. Single-station measurements recorded ambient vibrations continuously for periods ranging from several days to one week. Linear arrays were used for both passive ambient-noise recordings and active-source seismic measurements. Passive recordings at linear-array sites were generally acquired for approximately one hour, while active-source records were collected along the same profiles to support MASW and Refraction processing. Three passive circular arrays, with radii of approximately 10 m, 15 m and 50 m, were also deployed to support future investigations of deeper subsurface structure.

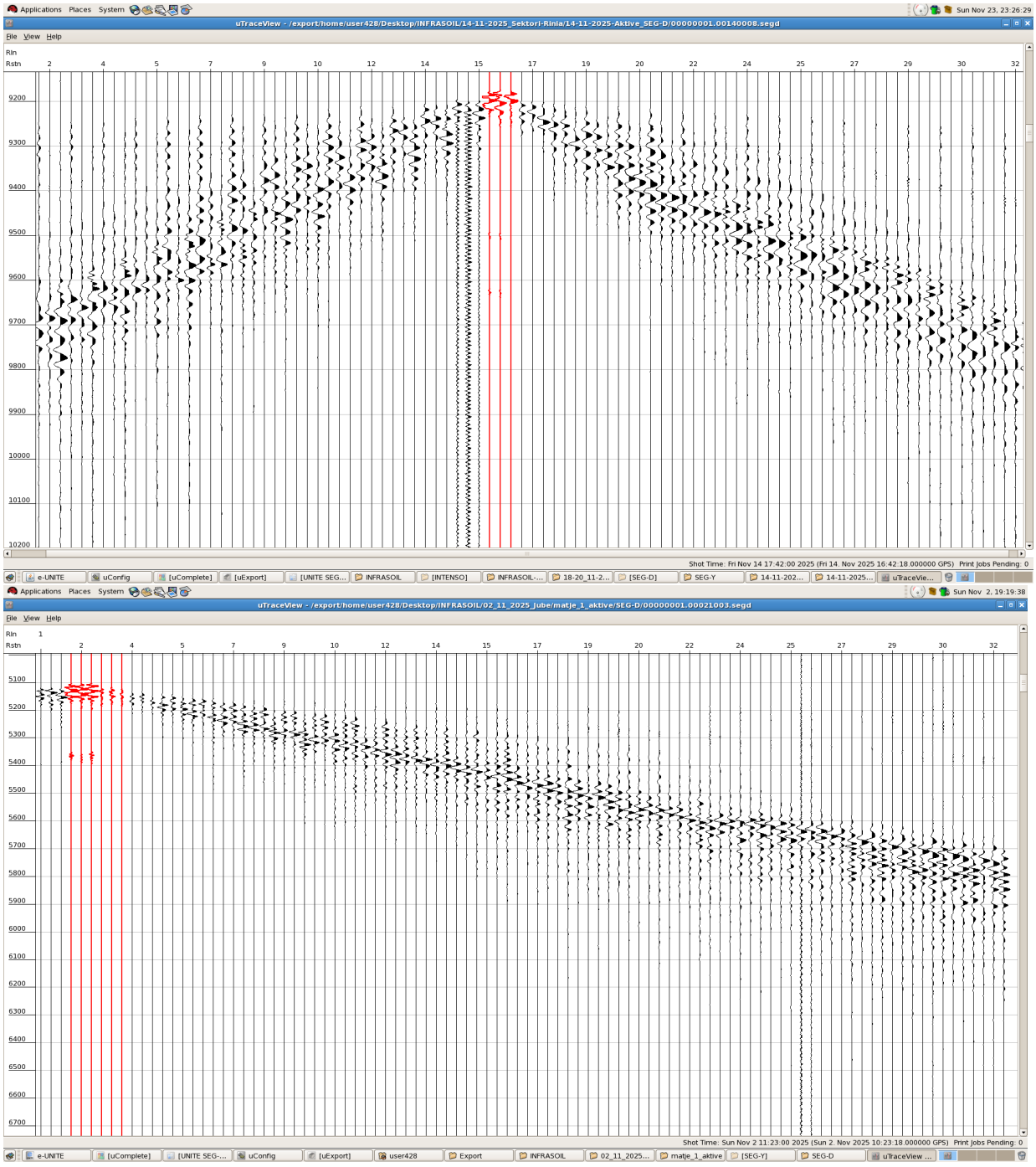

Figure 14. Recorded waveforms from the 32 three-component sensors.

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The raw field data were recorded in SEG-D format, which represents the primary archive of the acquired active and passive seismic measurements. Selected datasets were subsequently converted into SEG-Y and MiniSEED formats to support processing and compatibility with different seismic and geophysical software packages. The raw seismic data acquired during the InfraSoilArray field campaign are available through the Zenodo open repository under DOI: 10.5281/zenodo.20943643. The dataset includes the original field recordings in SEG-D format.

The dataset is of particular scientific value because it includes measurements from sectors where liquefaction-related ground effects were observed or documented after the 2019 Durrës earthquake, as well as from critical infrastructure and representative basin transects. It may be used by other researchers for independent analyses, comparison of passive and active seismic methods, local site-response studies, seismic microzonation, and the development, calibration or validation of geophysical and geotechnical models in soft coastal, lagoonal and alluvial sedimentary environments.

Ambient-noise recordings were processed using the Horizontal-to-Vertical Spectral Ratio method in the Geopsy H/V toolbox, following SESAME recommendations. The main extracted parameters were the fundamental resonance frequency f_0, dominant period T_0, H/V amplitude A_0 and seismic vulnerability index Kg. For linear arrays, representative site values were obtained by averaging reliable HVSR results from the individual sensors. Selected active-source profiles were processed using the Multichannel Analysis of Surface Waves method. Dispersion curves were extracted and inverted to obtain preliminary one-dimensional shear-wave velocity profiles, estimate Vs30 values and classify site conditions according to Eurocode 8.

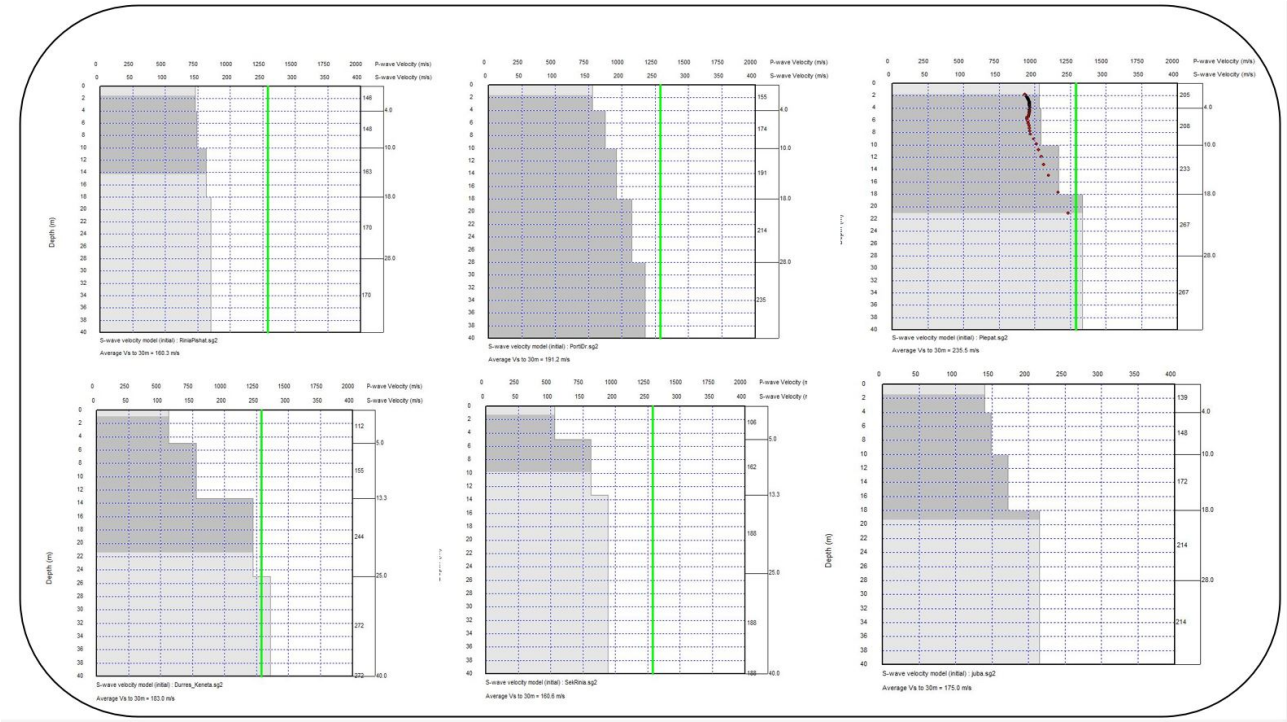

Figure 15. Some prelimanary results of Vs analyses.

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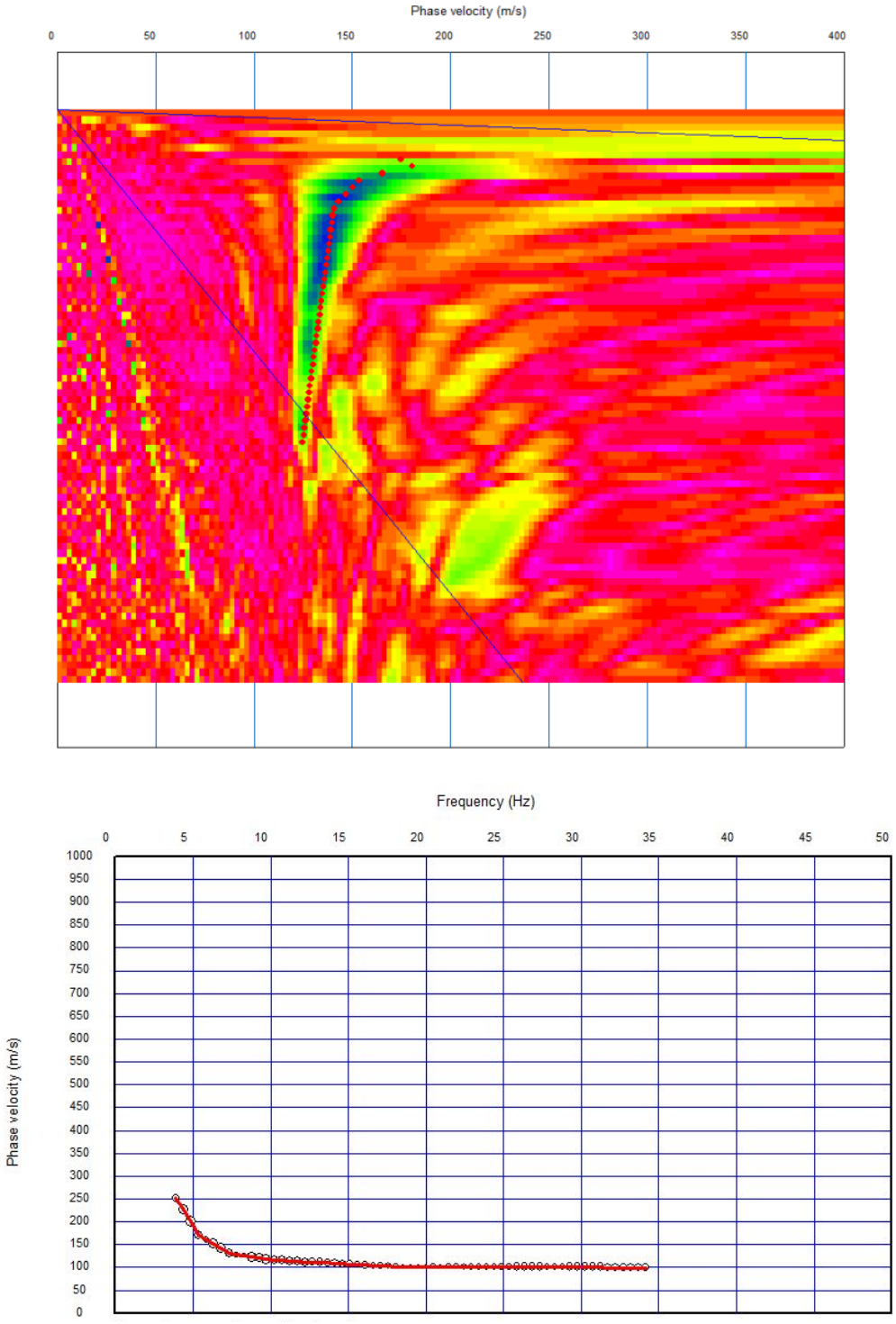

Figure 16. MASW dispersion analysis: (a) frequency–phase velocity dispersion image with picked points; (b) extracted phase velocity dispersion curve.

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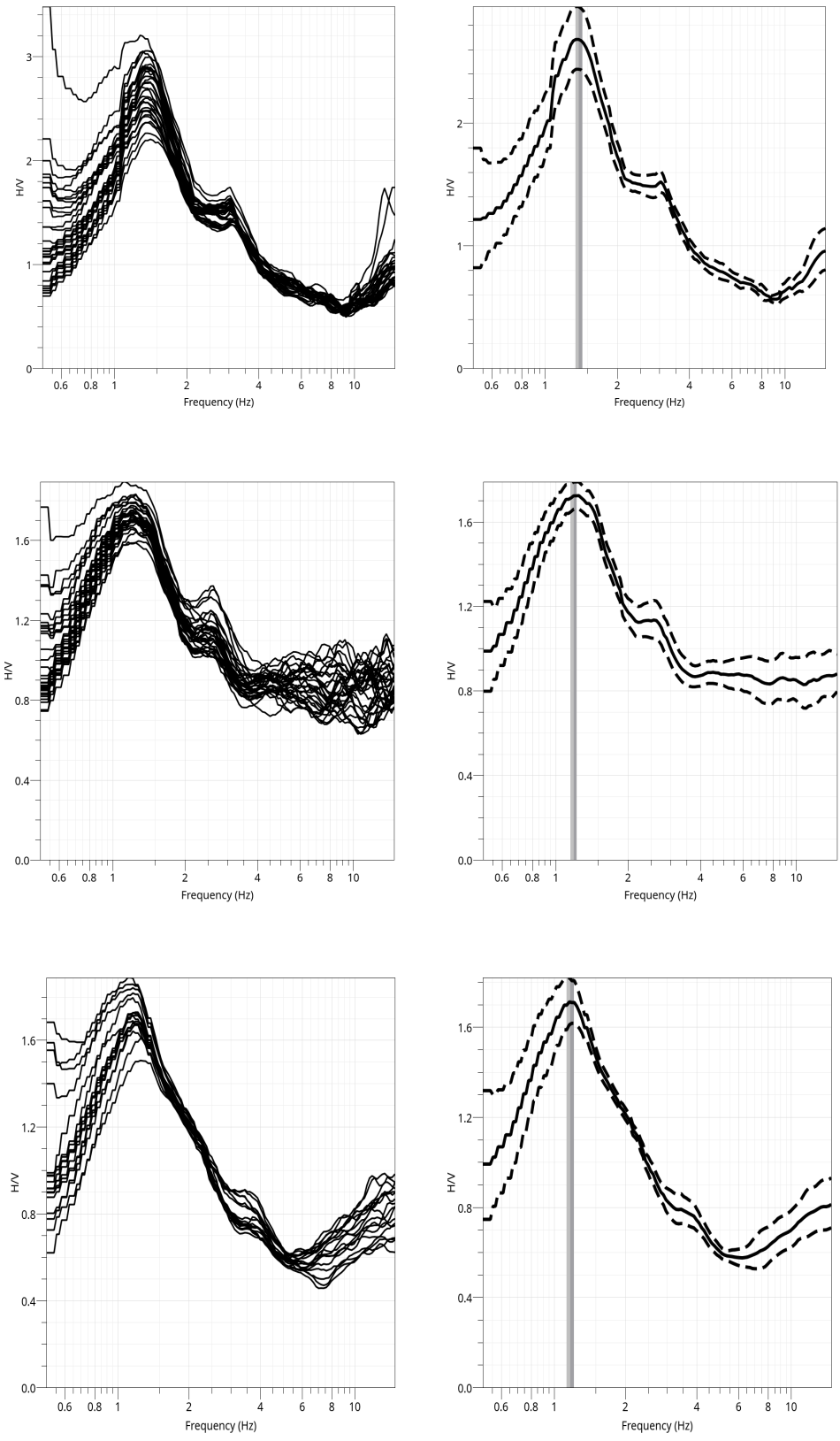

Figure 17. Some preliminary results of HVSR analyses using Geopsy package.

Preliminary results indicate significant spatial variability in local site response across the Durrës basin. HVSR results show resonance frequencies ranging approximately from 0.65 Hz to 7.5 Hz, with most central and coastal basin sites characterized by lower frequencies, generally between 0.8 Hz and 2.0 Hz. H/V amplitudes range approximately from 1.1 to 5.0. Preliminary MASW results indicate Vs30 values of approximately 160–236 m/s, corresponding mainly to Eurocode 8 soil Classes C and D. Lower resonance frequencies and lower shear-wave velocities were generally observed in the central and coastal sectors of the Durrës basin, while higher frequencies were observed toward basin margins and elevated geological formations. Overall, the activity provided a valuable first-order dataset for future detailed seismic microzonation, site-response mapping, infrastructure assessment and seismic risk-reduction planning in Albania.

Project outcomes:

The raw seismic field data acquired during the InfraSoilArray / Geo-INQUIRE Transnational Access activity are available through Zenodo under DOI: https://doi.org/10.5281/zenodo.20943643. The dataset includes the original SEG-D field recordings acquired with the MobSeis Mobile Seismic Array and is organized into active and passive seismic measurements. The data cover the Durrës sedimentary basin, selected sectors where liquefaction-related ground effects were previously observed, critical infrastructure sites, representative basin transects and complementary sites outside the main basin area.

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Selected datasets were converted from SEG-D into SEG-Y and MiniSEED formats for processing and compatibility with seismic and geophysical software. Geopsy H/V toolbox was used for HVSR processing, while selected active-source profiles were processed using MASW workflows for dispersion-curve extraction, 1-D shear-wave velocity inversion and preliminary Vs30 estimation.

Preliminary results from the access have been prepared for presentation and publication in the SGEM 2026 conference contribution entitled “Seismic Microzonation of the Durrës Basin, Albania: Preliminary Results from HVSR and MASW Investigations.” The results are planned to be presented in the SGEM 2026 section “Hydrogeology, Engineering Geology, and Climate-Resilient Geotechnics.”

Repository link to manuscript / accepted version: [to be added when available]

Published final version: [to be added when available]